SpR 2-1

P. W. ORR

OPERATIONS MANUAL
BLOWDOWN-BARK BEETLE SURVEY

Index

	Page
INTRODUCTION	1
ORGANIZATION	2
FLIGHT MAP PREPARATION	2
AERIAL OPERATIONS	2
Supervision	2
Piloting	3
Maintenance of Aircraft	5
Training	5
Observation and Mapping	6
Checking	10
FIELD OPERATIONS	13
COMPUTATIONS	23
DRAFTING, PUBLICATION AND DISTRIBUTION OF REPORTS, MAPS AND OVERLAYS	23
ADMINISTRATIVE PROCEDURES	23
Time reports, payrolls, leave	23
Personal	23

June 24, 1952

INTRODUCTION

Purpose of Survey. Widespread damage to timber stands by windstorms and the Douglas-fir bark beetle have occurred in western Oregon and to a lesser extent in southwest Washington since 1949. Generalized surveys of the insect damage, which occurred principally in 1951, have been conducted but do not provide detailed information of the location or amount of timber killed. No surveys of the wind damage have been carried out. In recognition of the need for an evaluation of both the damage so far incurred and the potential for future damage, the present survey was organized. Its objectives are as follows:

1. Provide an estimate of total volume lost in catastrophic amounts during the period 1949-51 and other salvable timber, which will include subtotal estimates of the following:

   a. All timber blown down during the winter of 1951-52.

   b. All timber blown down during the winters of 1949-50 and 1950-51.

   c. Douglas-fir timber killed by beetles in 1951.

   d. Other salvable timber.

2. Provide a map primarily for salvage use by timber owners showing reasonably detailed location or acreages where mortality in categories 1-a, b, c, & d is significant.

Areas to be Surveyed. The total area to be surveyed has been broken down into four priority zones as shown on the accompanying map and is based on the time and type of damage, which has been determined by preliminary surveys. The survey procedure to be employed between priority areas is variable and is described in detail under the section on procedures.

Aerial Survey Methods. Using 4 Cessna 170-B airplanes and crews of 4 men each, consisting of a pilot and 3 observers, the areas to be surveyed will be covered in predetermined grid or contour fashion depending on the topography of the various areas. Mapping will be done on 1-inch-to-the-mile topographic maps that have been organized by logical work units that can be completed in one or two days' flying time. Two of the observers will map windthrow mortality and the third man will map the groups of beetle-killed trees in place, in accordance with the detailed instructions given below for each priority area.

Ground Sampling of Aerial Examinations. Concurrent with the aerial work, ground crews will sample a selected number of the windthrow areas mapped from the air, in order to obtain volume data for mortality estimates of the area at large. A small amount of ground work will also be done on the beetle-killed areas. Close coordination between aerial and ground work will be necessary to insure a sufficient back-log of aerial observations for ground sampling.

Reporting of Results - Time Limitations. Completion date of the flying for the project has been set as August 15. This is necessary in order that a maximum of salvage of the infested standing and down timber can be accomplished this year, thus minimizing beetle losses in 1953. Each flight crew will be instructed to promptly send in survey results by relatively small mapping units in order that the maps can be reproduced and issued quickly to forest managers for use in salvage plans. Ground sampling will continue well past the completion date set for the aerial work.

ORGANIZATION

The organization chart shows the relationship of the various sections and individuals in the organization. Their duties are covered under work functions described later. The idealized work-flow chart also indicates relationship of the various sections.

FLIGHT MAP PREPARATION

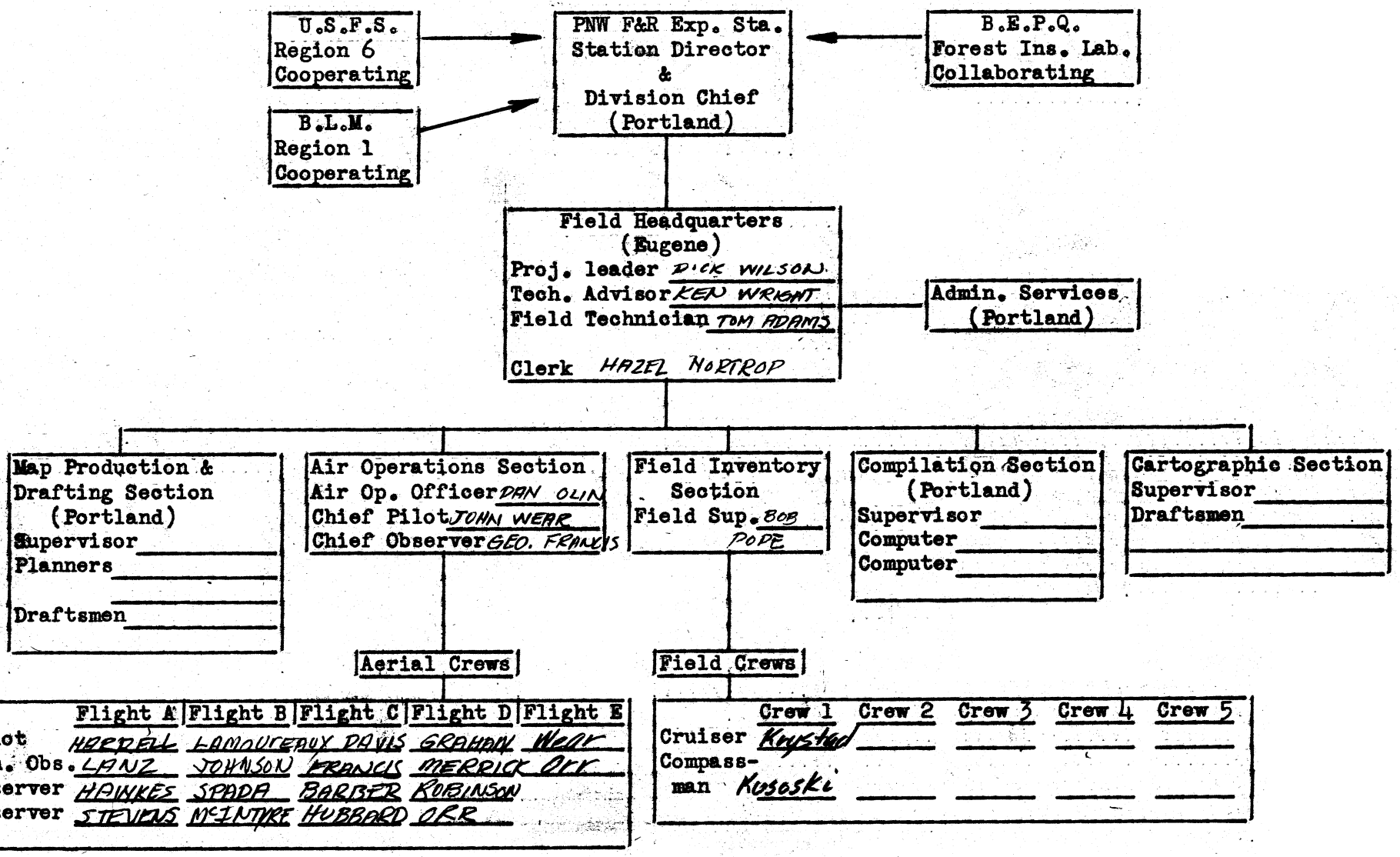
Flight maps will be prepared prior to aerial work by the Cartographic Section. Details of laying out mapping blocks and flight lines will be worked out by the Cartographic Section in close collaboration with the chief pilot and chief observer, or by alternates designated by them. Sufficient copies of each flight map will be prepared to furnish, at a minimum, each crew member (four) with a copy, and the operations section with a copy.

AERIAL OPERATIONS

Supervision.

General. All aerial operations will be under the general supervision of the Air Operations Officer or by an alternate designated by the project leader. The Chief Pilot and Chief Observer will report directly to the Operations Officer. The Air Operations Officer will dispatch all flights after checking with local air weather service and keep posted on locations of flights at all times. The Air Operations Officer should also keep currently posted throughout the day on changes in the weather situation, and to reroute flights as often as necessary. He has some primary responsibilities pertaining to safety which are covered under special safety precautions.

ORGANIZATION CHART BLOWDOWN-BARK BEETLE SURVEY



Piloting. The Chief Pilot will be responsible for training and passing on qualifications of all pilots assigned to the project. He will also periodically check-flight all pilots, and will perform other duties assigned by the project director or Air Operations Officer. He will check out each pilot in a Cessna 170-B aircraft for at least 2 hours of flying over terrain and under operating conditions typical of those on the project. This check will be made before the pilot will be permitted to fly operationally on the project.

All pilots must also meet the minimum following qualifications listed on pages 1-10 and 1-11 in the Forest Service Air Operations Handbook and must also have a currently valid commercial pilot's certificate with appropriate ratings and with a current medical certificate complying with Civil Air regulations and applicable State regulations.

1. At least 1000 hours of flying experience as pilot in command including the following:

2. At least 200 hours of cross-country flying.

3. At least 200 hours of flying in the typical terrain and the landing facilities similar to those on the survey project.

4. At least 100 hours in the general class of plane to be used by him on the unit as observation plane.

5. At least 100 hours during the preceding 12 months, of which at least 10 hours shall be under conditions described in (3) above.

6. Upon request, each commercial pilot shall furnish a certified statement of the following:

    a. Three character references.

    b. Accident record of all civilian airplane accidents involving any injury to persons or any damage to airplanes in which he was commanding pilot.

    c. Names and addresses of employers for whom he has flown airplanes the past three years or the three last employers for whom he has flown airplanes.

Except as noted below under exceptions, each pilot accepted for the project shall be subject to call and assignment by the Air Operations Officer on a day-by-day basis including week-ends for the duration of

the project. While he is operating in the air on these assignments he shall be under the immediate direction of a senior observer insofar as technical mapping and observation operations are concerned. Exceptions or additions to the above are:

1. The pilot shall be responsible for safety of operation of both plane and its crew. He shall comply with the directions of authorized personnel only when in his judgment such compliance will not be a violation of Civil Air Regulations, Directives of the Administrator of the CAA, Forest Service Air Operations Handbook instructions, and U. S. Forest Service Safety Code, or will not endanger the aircraft, its occupants or cargo.

2. Pilots have the authority to cancel, terminate, or change as necessary any flight when in their judgment such a flight is not safe. No Government officer can abrogate this authority of the pilot.

3. The maximum gross limitation of 2200 pounds shall not be exceeded and, as deemed necessary by the pilot, shall be reduced sufficiently to fully compensate for altitude, temperature, and other adverse flying conditions as may develop. The pilot is responsible for checking the load of each flight to prevent overloading. The Air Operations Officer shall have authority to reduce air loads whenever special conditions require this in the interest of safety.

4. The pilot shall be responsible for seeing that the plane is equipped with chest-pack parachutes for every flight. All crew members will wear the parachute harness at all times and have the parachutes conveniently on hand for immediate use. The pilot will check each observer for proper adjustment of his parachute harness and see that the parachutes are properly located in the plane. Shoulder harness provided for the plane will be worn by the pilot and observer in the front seat during take-off and landings, and at other times when in the opinion of the Air Operations Officer or the pilot the wearing of such harness is advisable. The pilot shall make certain that all crew members use seat belts properly.

5. No pilot including the Chief Pilot shall be permitted to fly more than 30 hours in six consecutive days or on more than six consecutive days. Because of adverse weather conditions on some week days the Air Operations Officer may require observation flights on week-ends when weather is suitable for such flights.

Maintenance of Aircraft.

Mechanic's responsibility. Aircraft maintenance shall be performed on a continuing daily basis by a qualified A & E mechanic using a standard inspection form under the general supervision of the Air Operations Officer. In addition to making a daily general inspection of the airplane engine, checking oil, gas, and electrical lines for leaks or loose connections, and inspecting all exterior surfaces, the A & E mechanic will pay special attention to any complaints on the airplane submitted by the pilot. Line inspection forms will be filled out and properly certified after each daily check by the rated mechanic. If, due to poor flying conditions, the plane is grounded for a day or more, each airplane will be reinspected by the A & E mechanic before that day's flight is made.

Pilot's responsibility. It will be the pilot's responsibility to report any plane discrepancies on the "squawk" sheet during or after each flight and check with the mechanic who services his plane to see that all such discrepancies are taken care of. The pilot will preflight his ship thoroughly before each flight and must be sure that his ship carries on take-off a minimum of 45 minutes reserve supply of gasoline above the amount required for the estimated round trip. He has other responsibilities specifically listed under "Special Safety Precautions.

Training - Air Crews.

Orientation of Pilots and Observers.

A. Ground orientation (no time limits).

1. Discussion of purpose of project.

2. Study of aerial photographs of windthrow and beetle damage.

3. Familiarization with 1"-to-the-mile topographic quadrangle sheets.

B. Air orientation (3 hours).

1. Observation of various intensities of windthrow and beetle damage.

2. Check of map sense using aeronautical charts.

3. Check of general air adaptability.

C. Aerial navigation (3 hours).

1. Tracking on quadrangle sheets at about 1500-2000 feet over relatively flat terrain with good land marks (1½ hours).

2. Tracking on quadrangle sheets at 1000 feet over dissected terrain with good land marks (Blachly area), (1½ hours).

Intensive Observer Training (6 hours).

A. Combination tracking and mapping windthrow at 1000 feet on quadrangle sheets with relatively good detail, (1½ hours).

B. Combination tracking and mapping windthrow on quadrangle sheets with limited roads and cultural detail (1½ hours).

C. Mapping of windthrow and/or beetle kill on Prairie Peak test area (1½ hours).

D. Mapping of windthrow and/or beetle kill on areas of difficult terrain and heavy damage (1½ hours).

Total minimum training time per man - 12 hours.

Observation and Mapping.

Priority I-A Area.

A. General Instructions. A 4-man crew consisting of a pilot and 3 observers will fly predetermined flight lines 1 mile apart and approximately 1000 feet above the ridge tops, mapping both windthrown and beetle-killed timber in place on 1"-to-the-mile topographic or planimetric maps. The two observers in the rear seat of the airplane will individually record recent windthrow for a distance of one-half mile each side of the airplane, while the observer in the front seat of the aircraft will plot the 1951 beetle-killed timber over the same area. Maps and map boards approximately 15"x 17", will be provided each of the three observers for the individual mapping. The pilot will also be supplied with a map and will be responsible for keeping the airplane on course and picking up successive flight lines. The predetermined flight lines will run generally north and south approximately along section lines, begin and end at the best topographic features available, and will vary from about 12 to 15 miles in length.

One man in each crew will be assigned the job of crew leader. His responsibilities will include planning of each day's work, mailing in completed maps, and general supervision of the activities of the crew.

Because proper lighting is a critical factor in spotting the damage, flying generally will only be done when 3-tenths or less cloud cover prevails, and between the hours of 10 A.M. and 3 P.M. (D.S.T.), with one hour out for refueling and lunch.

Areas of windthrow that are currently being salvaged will also be mapped, making the best estimate as to which category of damage they would have fit prior to removal of the down timber. A special notation on these areas should accompany the standard legend when mapping.

B. Mapping Instructions (see attached mapping legend)

1. Windthrow.

a. Areas of "heavy" windfall in uncut stands (where at least 25 percent, approximately, of the stand is windthrown) to be mapped to a 5-acre minimum.

b. Areas of "moderate" windfall in uncut stands (where an estimated 10-25 percent, approximately, of the stand is windthrown) to be mapped to a 10-acre minimum

c. All areas of windthrown timber in cut-over stands that approximate 25 percent or more of the reserve stand will be indicated approximately in place by mapping symbols, with no attempt made to establish boundaries of damage.

2. Beetle-killed trees.

a. All groups of 31 or more trees killed in 1951 to be mapped in place according to color symbol.

b. All groups of 6-30 trees killed in 1951 to be mapped in place according to color symbol.

c. Zones of "light" killing (where there is at least 1 dead tree on each 40 acres) to be mapped to 160-acre minimum.

C. Refinement of Aerial Mapping. In order to more closely tie in aerial plottings with subsequent ground sampling, approximately one-half hour at the end of each flight day will be spent on more accurately locating patches of windthrow that are especially appropriate for ground sampling, principally on the basis of accessibility to ground crews.

Priority I-B Area.

A. General Instructions. Procedure for mapping the windthrow and beetle-kill on this area will employ most of the techniques used for Area I-A. Beetle-kill is known to be heavy in much of the area, but 1951 windthrow is considerably lighter. Damage by wind in 1949-50, however, was extensive. Main objectives for mapping in this area, then, will be to map 1951 beetle-killed timber and windthrow occurring since the winter of 1949-50.

Since less emphasis will be placed on windfall in this area, flight lines will be flown 2 miles apart on the average; also, due to the more rugged terrain, the predetermined flight lines will follow contours rather than a grid pattern.

B. Mapping Instructions.

Windthrow. Same as for Area I-A except that windthrow will be mapped for only 1/4 mile from the plane and on the right side only, thus obtaining a 12½-percent sample of the area.

Beetle-killed trees. A 100-percent inventory of the groups of beetle-killed timber will be obtained for this area, but since the strips will be flown at approximately 2-mile intervals, one mile of coverage will be secured from each side of the airplane, rather than have one man map both sides as was done in Area I-A.

C. Refinement of Aerial Mapping. Because ground sampling to be applied in this area has not been completely worked out, final instructions for accurately locating certain points of damage mapped from the air for ground checking will be issued later in the project.

Priority II-A Area.

The program of work for this area has not been fully resolved and will depend largely on findings of preliminary scouting. Present plans are to conduct a broad reconnaissance survey of the area with a pilot and 2 observers and then apply the survey techniques used in Area I-B where significant mortality exists.

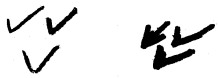
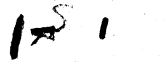
Priority II-B Area.

At present no survey plans for this area have been developed. However, if field reports indicate the need for some evaluation of localized damage, the procedures tentatively outlined for Area II-A will also be applied to this area.

Aerial Counts of Beetle Kills.

After considerable blocks of the project have been covered by the standard observation and mapping procedures a special flight, or flights, will be made with one pilot and one observer. These flights will normally be made by the Chief Pilot and the technical advisor. Representative beetle-killed tree groups will be carefully inspected from the air, and counts will be made of the number of dead trees in each group. Averages of these counts will be applied to the total number of beetle-killed groups in the project area to get an estimate of the total number of beetle-killed trees. Correction factors based on correlated ground and aerial counts of dead trees from a separate study will be applied to get a corrected total estimate. These data will go to the computation section for further analysis with other correlated data and for determination of total volume estimates of beetle-killed timber.

MAPPING LEGEND FOR AERIAL WINDTHROW AND BARK-BEETLE SURVEY

Intensity Class	Symbol and Color	
ON BLUE LINE MAPS →		
Heavy		(red)
Moderate		(blue)
(One class)		(blue)
ON BLUE LINE MAPS		
Heavy		+ (red)
Moderate		X (blue)
Light		(green)

A. Recent Windthrow in Uncut Timber Stands Over 40 Acres in Size

Heavy — 25% or more of stand windthrown (map to 5-acre minimum).

Moderate — 10-25% of stand windthrown (map to 10-acre minimum).

B. Recent Windthrow in Cut-over Stands or in Seed Blocks Less than 40 Acres in Size

(One class) — 25% or more of residual stand windthrown (map to 10-acre minimum, using one check for each 10 acres).

C. Beetle-Killed Trees (1951 Kill)

Heavy — Individual groups of 31 or more dead trees.

Moderate — Individual groups of 6-30 dead trees.

Light — General area where at least one group of 2-5 dead trees occurs on each 40 acres (map to 160-acre minimum).

7/16/52 May be mapped in place or could be mapped after the flying is over to show broad grouping of light kill.

Checking. To insure maximum uniformity of observations, both within and between the four crews, a system of checking the aerial work will be necessary. On each crew the senior observer will be responsible for assisting the men under his supervision in making decisions on mapping, windthrow and beetle-killed timber. He will also check the tracking alertness of the other two men in his flight approximately 10 times each day by asking the men to record the airplane's location on their maps. No warning of this request will be made and each man, including the senior observer, should record the position immediately when asked to do so. The maps will then be compared at the end of each day's work to determine the tracking accuracy of each man.

The chief observer will be responsible for coordinating the mapping efficiency of the four crews. He should confer periodically with the senior observers of each crew as to the work of the men under their supervision and any problems that need attention. If unsatisfactory

work is being done by an observer, the chief observer should immediately take steps to correct the situation.

Further checks on accuracy and uniformity of both windthrow and beetle-kill mapping will also be conducted by the project leader (or by someone designated by him) and by the Chief Pilot. They will spot-check the mapping by reflying selected flight lines.

Special Safety Precautions.

Policy and objectives on safety. On this operation the standard R-6 Forest Service policy is applicable: "No job is so important and no service is so urgent that we cannot take time to do our work safely." Each employee has a responsibility to prevent accidents. Our objective in applying safety measures will be to complete the project with no fatalities, no lost-time personal injuries, and no property-damage accidents.

Action on safety measures. If any employee notes procedures where reasonable safety measures appear to be violated he should immediately call his supervisor's attention to those procedures. The supervisor must then take corrective action as may be necessary.

Particular points of procedure deserving continued attention:

1. Maintain flights approximately 1000 feet above the ground or higher.

2. Maintain air speed at 65 m.p.h. or greater (when stall indicator sounds this indicates aircraft is in a dangerous attitude).

3. Level off at normal cruising speeds if cylinder-head temperature gauge reaches danger point (red line).

4. Take frequent rest periods during flight from concentrated tracking and mapping (every half hour or 45 minutes stop tracking and mapping for five minutes, and land during lunch period if practicable).

5. Pilots should see that fire extinguisher is always aboard aircraft.

6. Pilots should see that 10-man first aid kit is available in each aircraft.

7. Wear or keep your chest-pack parachutes easily accessible at all times.

8. Avoid approaching and entering aircraft with a burning cigarette or while aircraft is being refueled.

9. Don't smoke in aircraft.

10. Avoid damaging interior of aircraft while loading or unloading.

11. Avoid getting out of aircraft on ground before being instructed to do so by the pilot.

12. Pilots should check frequently during flight on gasoline guages.

13. Fasten seat belt for take-off and landings.

14. Pilots should be thoroughly familiar with Forest Service Air Operations Handbook, especially pp. 1-1 to 1-15, 1-21 to 1-33, 1-37 to 1-42. Pilot should also be familiar with "Mountain Winds and Their Effects on Flight," published by Civil Aeronautics Board.

15. All personnel should be familiar with the Forest Service Safety Code, especially pages 2-15 on airplanes.

16. The Air Operations Officer has authority to ground any pilot or any plane at any time for safety reasons.

17. The project leader shall provide for independent weekly safety inspections of the operation at intervals no greater than 2 weeks.

18. The Air Operations Officer will maintain a complete list of emergency air strips in the project area.

19. The project leader and the Air Operations Officer should make changes in safety regulations on the project whenever improvements can be made.

Emergency Search and Rescue Plan. The Air Operations Officer should have an emergency search and rescue plan outlined and coordinated with the various national forests and the CAA covering the project area. He should also be prepared to put that plan immediately into effect in case of a reported crash. He, or his alternate, should maintain radio contact, either direct or through local CAA facilities, with all project flights and should have locations of each flight indicated on the operations map. All flights will make radio contact with the CAA or with the Air Operations Officer at least once each hour at times set by the Air Operations Officer.

Crash and Fire Protection Facilities. At the home base the Air Operations Officer should see that adequate carbon dioxide fire extinguishers and other fire protection facilities as needed, are available at all times. The Air Operations Officer will arrange for crash facilities with definite plan of action at the base.

FIELD OPERATIONS

SAMPLING FOR BLOWDOWN

Supervision. Supervision of the field operation phase will be carried out by the field supervisor. He will be responsible for organizing, equipping and training the field crews and furnishing transportation. When the operations are under way the field supervisor will be responsible for directing the field crews. He will obtain the aerial reconnaissance maps from the air crews and prepare them for the field sampling. He will lay out the work for each field crew, preferably in units of at least a week's work. He will spend much of his time in the field with the field crews, attempting to devote a day with each crew at least once each two weeks. On such visits he will outline future work for the crews and accompany them on a field plot to make sure all crews are adhering to the same standards.

Priority I-A Area.

Sampling Procedure.

Types of Samples.

A. Heavy - In areas mapped as heavy blowdown, 1-acre plot, 1 chain by 10 chains.

B. Moderate - In areas mapped as moderate blowdown, 2-acre plot, 1 chain by 20 chains, horseshoe-shaped, 5 chains, 10 chains, 5 chains.

C. Light - In all remaining areas of saw timber and pole timber where no blowdown of the above two classes has been mapped, 4-chain plot, 1 chain by 40 chains, horseshoe-shaped, 15 chains, 10 chains, 15 chains.

Number of Plots. It is estimated at present that about 225 field plots will be needed for a sampling error of 10% on the total volume of 1951-52 blowdown in Douglas-fir. Prior to the start of the aerial mapping this total number will be allocated to the three types of samples. This will be done on the basis of the best available information on

volumes and coefficients of variation expected. These proportions, with an added safety factor, will be used by the air crews in determining the numbers of areas to be earmarked by the air crews for ground samples during the period of aerial mapping before the start of the ground work. Just before the start of the field work all aerial mapping completed will be used to revise the allocation of field plots if necessary. An attempt will be made to retain this distribution throughout the course of the survey. Should a radical change of plot distribution seem desirable at any later time, it will be necessary to regard work done before and after the change as two separate strata.

Selection of Plots. It is recognized that many of the areas of heavy and moderate blowdown mapped by aerial reconnaissance will have a substantial error in location. In order to minimize the lost time incurred by field crews searching for mislocated blowdown areas, those to be sampled by field plots will be selected from the air and their location verified or corrected. Within the area mapped on any particular day, these sample areas will be selected by the air crews after completing the mapping and while still in the air over the area. The method for determining the numbers of plots for any mapped area is described under A below and the method for locating these areas is described under B below.

A. Number of Plots by Sample and Work Day.

1. Heavy and moderate sample. Prior to the start of the aerial mapping the best estimate possible will be made of the expected total number of heavy and moderate areas in the priority I-A Area. This will provide the basis for estimating that every nth heavy and every mth moderate area will be sampled. These ratios, boosted by a safety factor, will be used by the air crews to determine the number of heavy and moderate areas to be picked for field sampling in any given area. At the end of each day's aerial mapping the Senior Observer on each crew will count the number of heavy and moderate areas mapped and use the above-mentioned ratios to determine the numbers of areas to be selected for field sampling.

   Just before field work begins all aerial mapping done to date will be analyzed and the sampling ratios adjusted, if necessary. These adjusted ratios will be used to select the actual number of field samples from

among the areas earmarked by the air crews. These ratios will also be used from this time on by the air crews in determining the numbers of areas to be earmarked during each day's aerial mapping.

2. Light sample. Prior to the start of the aerial mapping an estimate will be made of the fraction of the gross area in saw-timber and pole-timber types, not mapped as either heavy or moderate blowdown. The number of field plots desired in the light blowdown sample will be divided by this fraction to provide an inflated number of samples. If this inflated number of points be distributed systematically over the gross area then the number falling in either saw timber or pole timber should be about the number desired as field samples. In addition, the number of these points qualifying as either saw timber or pole timber on any given area will be approximately in proportion to the amount of these types in that area. This provides a means for determining approximately the desired number of plots in the light blowdown sample for the gross area mapped each day.

The inflated number of points will be systematically distributed throughout the gross area. They will be marked along flight lines on the pilot's copy of the maps. During the course of the aerial mapping on a particular day the pilot will examine the ground at each of these points and mark any which fall either in saw timber or pole timber. The number of points which so qualify on any particular day is the number of plots desired in the light blowdown sample.

B. Location of Areas to be Sampled. Having completed the aerial mapping for a particular day and determined the numbers of plots required in each of the three samples for that particular area, the air crew must now select the particular areas for these plots. The method for doing this is described below:

1. Heavy and Moderate Sample. After determining the numbers of plots required for a particular day's work, while circling in the vicinity of the end of the last flight line, the air crew will fly back across the area on a line from the end of the last flight line through the center of the area. Areas to be sampled will be picked in the vicinity of this line. Sample areas of heavy and moderate blowdown must meet four qualifications: (1) they must

be within 1/2 mile of a road; (2) heavy blowdown areas must have a minimum area of 10 acres and moderate areas 20 acres; (3) they must be accurately mapped as to location, hence, must be fairly near some recognizable topographic feature; (4) the minimum distance between sample areas in the same class of blowdown is 2 miles. As the crew flies back across the area on this selected line the first mapped area of heavy or moderate blowdown which meets the first two qualifications will be inspected. If it has been properly located on the map it will be checked in black for a field sample. If it has not been properly mapped, its location will be adjusted so that it is properly mapped, if possible. If the area initially selected as a sample falls at such a distance from definite topographic features that it seems impossible to map its location accurately, it will be rejected and another chosen.

Having so checked one area for field sampling, the crew will proceed along the selected line choosing other areas until the required number of both heavy and moderate samples has been picked. There is no minimum distance between samples in different classes of blowdown. In the event that the far side of the mapped area is reached before all required plots have been picked, the crew will return across the area in the opposite direction on a line parallel to and two miles distant from the first line.

2. Light Sample. Locations of areas to be sampled in the light blowdown class will be chosen by the air crews at the same time that samples are picked for the heavy and moderate samples. Qualifications for sample areas are: (1) areas must be of one stand-size class, either saw timber or pole timber, and have a minimum area of 40 acres; (2) areas must be adjacent to a road or otherwise easily accessible; (3) the minimum distance between plots in this type of sample will be two miles.

Since areas of this type of sample are not mapped, the process for picking those to be sampled will consist of inspecting the ground while flying along the line selected for picking samples. The first area meeting the qualifications listed above will be marked in black in its correct location on the map. Additional such areas will be picked along the line until the required number is met.

3. Miscellaneous Instructions. During the process of selecting the areas to be sampled in the field it may be possible for the air crew to indicate certain features that would help guide the ground crews to the sample areas. These would include roads to the sample areas not shown on the maps, and cutting boundaries.

Marking Location of Plots on Map. The actual location of the plots within the areas to be sampled will be done by the field supervisor. The starting point for the plot center line will be pinpointed on the map. The distance of the starting point from the edge of the mapped areas of heavy and moderate blowdown will be chosen at random in order to insure a representative sampling of both the edge and the center of these areas. In the light samples the distance of the starting point from the road or edge of the stand will be 5 chains. The shape and size of the plot will also be drawn and the azimuth of the first segment of the plot center line will be noted on the map. Each plot will be numbered using a separate series of numbers for each of the three classes of blowdown.

The adjusted estimates of required numbers of plots previously described under "Number of Plots by Sample and Work Day" will be made before field work begins. Since a safety factor was added in determining the numbers to be selected by the air crews, it is presumed that these numbers will be in excess of the adjusted ratios. The adjusted numbers of plots will be selected at random from those picked by air crews and will be numbered on the maps. The remaining areas picked by air crews will be given separate numbers as alternates. Field crews will select alternates to replace regular plots in the event that one fails to qualify as either saw timber or pole timber, or cannot be approached by road.

Field Procedure. At this point the maps with plots located and numbered are turned over to the field crews. Field crews will proceed as follows:

Location of Plot Starting Point. Drive as close as possible to the starting point. Select a reference point, recognizable both on the map and on the ground, which is closest to the plot starting point. Measure on the map the distance and direction from the reference point to the starting point. Go to the reference point by the easiest route and from there, by predetermined direction and distance, to the plot starting

point. Use compass and pace unless extremely rough country necessitates chaining.

In the samples of moderate and light blowdown there will be no adjustment of this starting point. However, in the heavy blowdown sample the plot starting point can be adjusted if it appears that the plot will not sample the blowdown.

Plot Work.

A. Procedure. From the starting point lay out the chain-wide plot for the predetermined direction and distance. The compassman will establish the direction and length of the line, be head chainman, and tally information given him by the estimator. The estimator will be rear chainman and make the slope corrections where necessary. He will be responsible for establishing the width of the plot and for making the necessary measurements and estimates.

The first segment of the line will be run on the azimuth indicated on the map for the required distance. Then, in the case of the horseshoe-shaped plots, the plot center line will be turned 90° as shown by the shape of the plot marked on the map. After the required distance on this segment of the plot line, another 90° turn will be made and the final segment run.

B. Plot Card Heading. Fill out all plot card headings.
Priority refers to the area being sampled, either I-A or I-B.
Sample refers to the three classes of blowdown. Mark (H), (M), or (L) for heavy, moderate or light respectively.
Plot number will be marked on the map and should be duplicated on the card.
County is self-explanatory.
T., R., and Sec. refers to the township, range and section within which the plot is located. In case the map is not sectionized, estimate the section.
Az. Lgth. refers to the azimuth and length of the three segments of the plot center line for the moderate and light samples. For the heavy samples fill in only the first segment.
Decl. refers to the magnetic declination set off on the compass used to run the line. This should be set to the nearest degree for each locality worked from the best available information.

Stand size will be either ST for saw timber or PT for pole timber and refers to the size of the stand through which the plot runs. In determining stand size a minimum stand area of 40 acres will be used. To qualify as saw timber the stand must average 5 M net per acre in trees 11.0" or larger. To qualify as pole timber the stand must have a plurality of basal area in trees 5.0" or larger but fail to qualify as saw timber.

No. green will be explained under the next section.

C. Information Tallied.

1. The following species will be tallied using the indicated symbols:

Douglas-fir	D
Engelmann spruce	ES
Sitka spruce	S
Western hemlock	H
California incense-cedar	IC
Western redcedar	C
Lodgepole pine	LP
Ponderosa and Jeffrey pine	P
Sugar pine	SP
Western white pine	W
True firs	F
Western larch	WL
Other western softwoods	SW
Aspen	AS
Red alder	RA
Other hardwoods	HWD

2. DBH will be tallied in 4-inch classes. Lower limit for a class will be 1.0 inch below the lower class title. Upper limit will be the upper class title plus 0.9". Thus, the limits of the 20-22 class will be 19.0"- 22.9". DBH class will generally be estimated, with occasional checks by biltmore stick or diameter tape.

3. The following classes of trees will be tallied by species and DBH, regardless of their merchantability:

a. All trees blown down within the last year (since summer '51) which were alive at the time.

b. All trees blown down during the two previous years (summer '49 - summer '51) which were alive at the time.

c. All standing Douglas-fir trees beetle-killed within the last year (same class as tallied in bark beetle survey).

d. All other salvable dead trees, standing and down (trees 25% or more merchantable.)

4. Tally the total number of standing green trees 5.0" and larger, regardless of species or DBH, and record on plot card heading after No. Green _____.

5. Within each of the four classes of trees mentioned in 3 above, certain sample trees will be selected for additional estimates as follows:

a. In the class of 1951-52 blowdown every 10th saw-timber tree (12" or larger) will be selected as a sample tree. These will be tallied both in the regular columns and also in the space provided for sample trees. Space for six samples is provided and this is the maximum number of trees in any class that will be selected as samples. In the space provided for sample trees, the following information will be recorded:

(1) Sp - species.

(2) DBH - In 2" classes.

(3) Ht - Height. Merchantable height in number of 16-foot logs. Upper limit of merchantability will be the point where diameter inside the bark is approximately 40% of DBH, but not less than 8".

(4) Cu - Cull. The amount of defect present in the tree expressed as a percent of the gross volume within the merchantable limits.

(5) Bk - Breakage. The amount of breakage actually present in the tree, or likely to occur in the harvesting operations, expressed in the same manner as cull.

b. In the class of the 1949-51 blowdown every 5th saw-timber tree will be selected as a sample tree and tallied in the same manner as the previous class with the following exceptions:

(1) Cu - Cull. In this class of blowdown the cull recorded will be an estimate of the amount of defect present at the time of death.

(2) Mr - Merchantability. This is the percent of gross volume merchantable at time of tally after deducting present cull and actual or likely breakage.

c. In the class of standing Douglas-fir beetle-killed within the last year, every fourth tree will be selected as a sample tree and tallied in the same manner as the class of 1951-52 blowdown except that there will be no estimate of breakage.

d. In the class of other salvable dead trees every fifth tree will be selected as a sample tree and tallied in the same manner as the 1949-51 blowdown class except that no cull is needed--only present merchantability.

Priority I-B Area.

Sampling Procedure. Sampling procedure in priority I-B area will be similar to that in the I-A area. The same three classes of blowdown will be mapped and crews will follow similar procedures in earmarking areas to be sampled by field plots. In two aspects the sampling procedure on this area will differ from that on area I-A.

Since the best available information indicates that 1951-52 blowdown is much lighter in this area, fewer field plots will be taken. Present plan is to take about 50.

Because of the relatively complete transportation system in area I-A, it was reasonable to assume that neither volume nor species composition was associated with accessibility. However, in area I-B a correlation between these factors is likely. In order to avoid the bias which might result from restricting field plots to reasonably accessible areas, priority I-B area will be divided into two strata on the basis of species, types, and accessibility. Fewer plots will be taken in the inaccessible stratum. More detailed instructions will be issued later.

Field Procedure. Field procedure will be identical with that in area I-A.

Training. Because of the unknown and probably variable experience of field personnel, no rigid training schedule will be set up. However, before field crews begin plot work they will undergo a period of training by the field supervisor or other qualified personnel. This period will probably vary from one to several days depending on the past experience of the field crews. The following subjects will be covered:

Orientation - Purpose and general plan of the survey. Procedures for mapping and selecting samples.

Map Reading - Locating and identifying topographic features on topographic and planimetric maps.

Plot Procedure - Locating and laying out plot. Use of instruments. Estimation of species, DBH and merchantable height. Selection of sample trees. Filling out plot card and tallying required information. Special emphasis will be placed on identification of the four classes of trees to be tallied, and estimation of cull, breakage and merchantability.

Safety.

Automobile Travel. Vehicles must be kept in good mechanical condition. Follow instructions in equipment record log regarding lubrication and oil change. Any mechanical deficiencies that develop must be repaired immediately. Field supervisor will arrange to supply transportation in case any vehicle is laid up for repairs.

Drivers are liable for any damage caused to life or property. They should make sure that they have liability insurance covering them when driving government-owned vehicles.

Accident-reporting forms and first-aid kits will be carried in all vehicles.

Field Work. Field work in areas of blowdown is extra hazardous. Crews will consist of two men for this reason.

Caulked boots and clothing heavy enough to protect against scratches are a necessity.

Hand axes and any other sharp tools must be carried sheathed at all times except when actually in use.

Pocket first-aid kits will be carried on all plots and snake-bite kits will be carried whenever in areas where poisonous snakes may be encountered.

Above all, do not be in a hurry. Take time to be sure of your footing and don't take chances.

COMPUTATIONS

Computation procedures will be outlined later after air operations and field work are under way, but prior to beginning of computing work.

DRAFTING, PUBLICATION AND DISTRIBUTION OF REPORTS, MAPS AND OVERLAYS

These procedures will be outlined later.

ADMINISTRATIVE PROCEDURES

Time reports, Payrolls, Leave. Most of the administrative work will be done in Portland. Procedures at the project headquarters and in the field will be done as directed administratively, and will require generally making out time reports and leave records. Payrolling will generally be accomplished by permanent unit from which employee has been detailed. Salaries and per diem will be reimbursed from project allotment to payrolling units. Other field expenses will be handled directly from project allotment. Aerial operations, and related field operations as well, may be partly accomplished on week-ends to take advantage of suitable flying weather. This will require adjustments in the work week, or overtime adjustments which will be worked out administratively as the project progresses.

Office space for air operations will be available at Eugene Air Park, and normally all flights will return to that base every night. Field supervisor's office will also be at Eugene.

Personal.

1. Mailing address for project and for all employees stationed at Eugene will be c/o U. S. Forest Service, Eugene, Oregon.

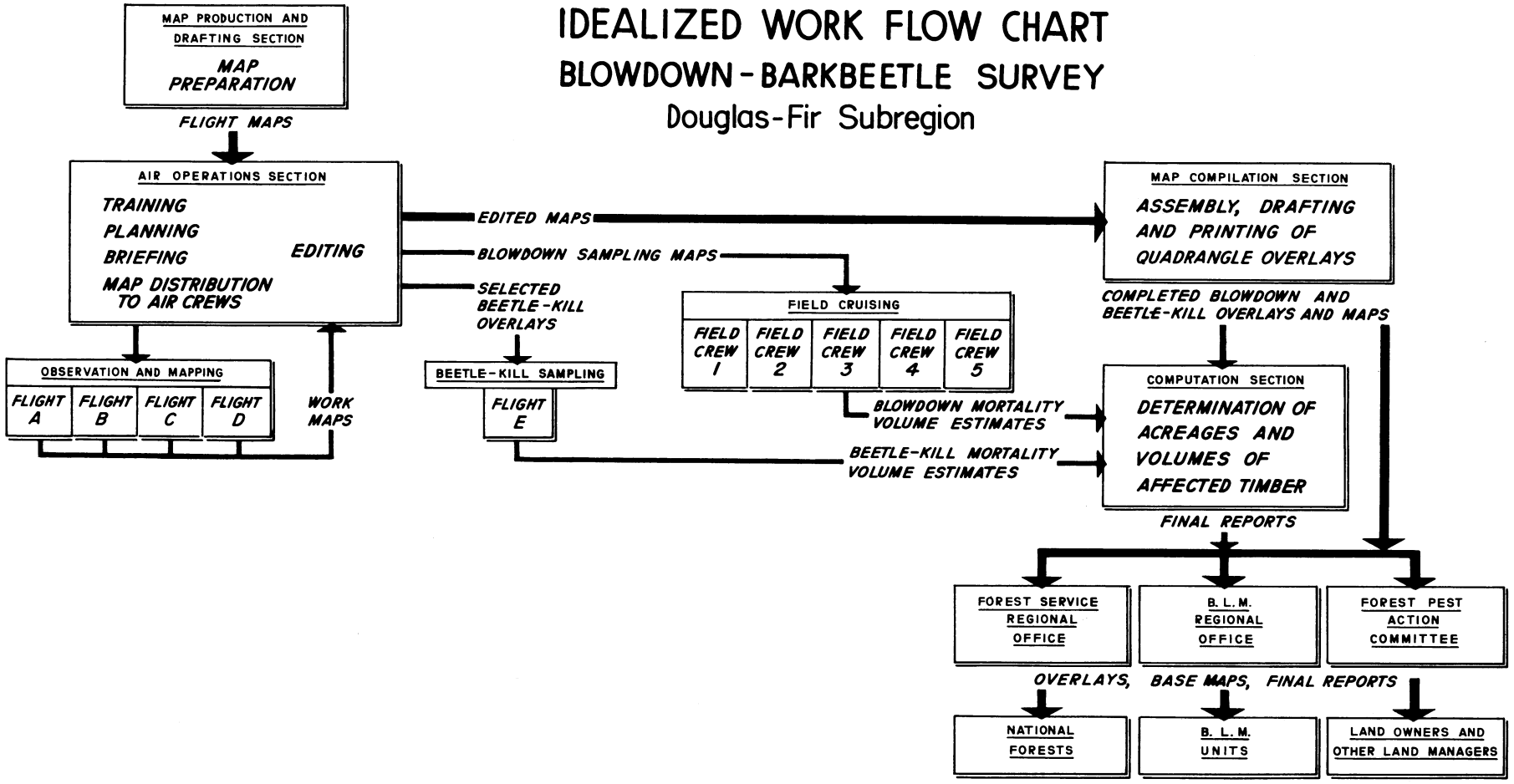
2. No special personal gear will be needed for flying personnel, although baseball caps and sun glasses are advisable.

3. It will be necessary to secure food and lodging at commercial establishments at Eugene or at other field points visited.

4. Observers subject to occasional air sickness are encouraged to take one or two drammamine tablets about one hour before take-off time. These tablets will be provided at the air operations office.

5. The air operations section will have information on flight insurance.

IDEALIZED WORK FLOW CHART
BLOWDOWN - BARKBEETLE SURVEY
Douglas-Fir Subregion



PRIORITY AREAS FOR BLOWDOWN-BARKBEETLE SURVEY

Douglas-Fir Subregion